Advanced Si Immersion Gratings with High Performance to the Short Wavelength Cutoff

Completed Technology Project (2015 - 2018)

Project Introduction

We propose here a program to push the performance of silicon immersion gratings to the point where they work well across the whole wavelength range that the material properties make available (1.15 - 6.5 microns). In a collaboration with the National Institute of Standards and Technology (NIST), we will also develop a new patterning technique that offers the possibility of higher quality gratings, larger devices, more manufacturing flexibility, and a way to piggyback on future improvements in industrial lithographic technology. These improvements can significantly broaden the usefulness of Si gratings for future space missions and ground-based instruments. Silicon immersion gratings enable infrared spectrographs with an order of magnitude smaller instrument volume at a given resolving power. They also make it possible to design high-resolution spectrographs with broad continuous wavelength coverage. High resolution IR spectroscopy is an important tool in the quest for an understanding of the origin and the nature of planets around other stars. It permits us to study the molecular contents, kinematics, and excitation of protostellar disks. High-resolution IR instruments can also reveal detailed information about the composition and physical state of exoplanet atmospheres through transit spectroscopy, high-contrast AO direct spectroscopy, and phase-adjusted spectroscopic extraction. Our group has already delivered silicon transmission gratings for several NASA flight programs. Our first Si immersion grating instrument, IGRINS is undergoing commissioning in March 2014 and illustrates the power and promise of the technology. With the proposed development work, we seek to improve the accuracy of the gratings by a factor of two, eliminate the cause of the last remaining defect in the spectral point spread function, improve and qualify a production pathway using contact photo-lithography, and explore a new fabrication method based on direct-write laser lithography.

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Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Responsible Program:

Astrophysics Research and Analysis

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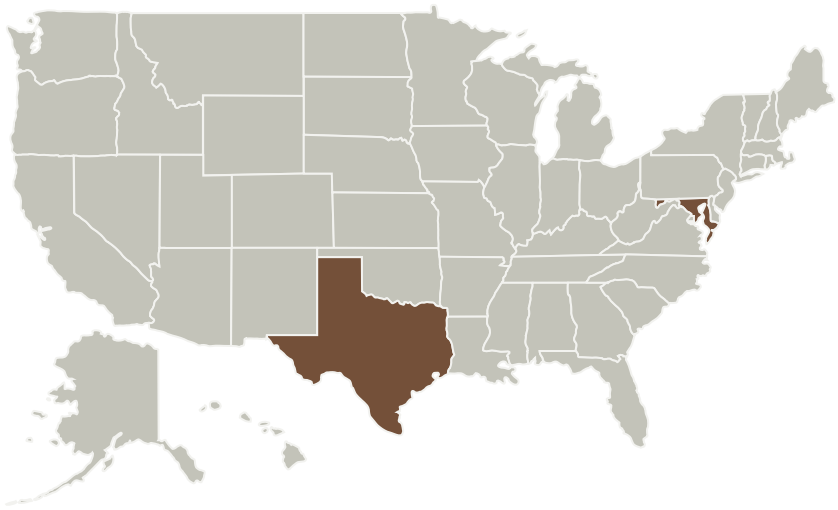
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
The University of Texas at Austin	Supporting Organization	Academia	Austin, Texas

Primary U.S. Work Locations	
Maryland	Texas

Project Management

Program Director:
Michael A Garcia

Program Manager:
Dominic J Benford

Principal Investigator:
Daniel Jaffe

Co-Investigators:
Cynthia Brooks
Ulf Griesmann

Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.1 Detectors and Focal Planes

Target Destination

Outside the Solar System